

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A laser weld quality monitoring method comprising:
welding a part of work with a laser beam irradiated thereon from a YAG laser;
detecting a varying intensity of light from the welding part to provide a detection signal;
determining a value of signal power of a frequency spectrum in a specified frequency band of the detection signal, the specified frequency band having a specific relation with a porous state of the welding part; and
making a decision for [[a]] the porous state of the welding part;
to be significant as the value of signal power exceeds a threshold of weld quality, and
to be insignificant as the value of signal power does not exceed the threshold of weld quality.
2. (Original) A laser weld quality monitoring method according to claim 1, wherein the detection signal comprises a varying electrical signal representing the varying intensity of the light from the welding part, and the determining the value of signal power comprises calculating a set of frequency spectra of the varying electrical signal.
3. (Original) A laser weld quality monitoring method according to claim 1, wherein the specified frequency band is varied depending on one of a thickness of the work, a welding speed, and an aspect ratio of a keyhole at the welding part.
4. (Original) A laser weld quality monitoring method according to claim 1, wherein the determining the value of signal power comprises one of passing the electrical signal to a band-pass filter and applying a Fourier transform to data of the electrical signal.

5. (Currently Amended) A laser weld quality monitoring method comprising:
irradiating a laser beam from a YAG laser to a welding part of work;
detecting light reflected from the welding part;
calculating a frequency distribution from a set of data of the detected light within [[a]]
an interval of time;
calculating, from the frequency distribution, a first signal power sum in one of a first
frequency band for detecting an under-filled state and a second frequency band for detecting a
porous state, and a second signal power sum in a third frequency band for detecting a non-
welded state;
mapping a combination of calculated values of the first and second signal power
sums, in a region defined by a combination of a first axis representing the first signal power
sum and a second axis representing the second signal power sum, including a sub-region
representing a non-conforming state as one of the under-filled state, the porous state, and the
non-welded state; and
making a decision for the welding part to have the non-conforming state, as the
combination of calculated values is mapped in the sub-region.

6. (Original) A laser weld quality monitoring method according to claim 5,
wherein the calculating the frequency distribution comprises converting the detected light into
an electrical signal, storing data on time-dependant variations of the electrical signal, and
calculating the frequency distribution from the stored data.

7. (Original) A laser weld quality monitoring method according to claim 5,
wherein the region includes sub-regions representing the under-filled state, the porous state,
and the non-welded state, respectively.

8. (Original) A laser weld quality monitoring method according to claim 5,
wherein the region includes a sub-region representing a conforming state of the work.

9. (Original) A laser weld quality monitoring method according to claim 5, wherein the region includes a sub-region representative of at least two of the under-filled state, the porous state, and the non-welded state.

10. (Original) A laser weld quality monitoring method according to claim 5, further comprising:

calculating, from a subset of the set of data, a subsidiary frequency distribution of the detected light within a sub-interval of the interval of time;

calculating, from the subsidiary frequency distribution, a first subsidiary signal power sum in one of a first subsidiary frequency band for detecting an under-filled state in a sub-section of the welding part corresponding to the sub-interval and a second subsidiary frequency band for detecting a porous state in the sub-section, and a second subsidiary signal power sum in a third subsidiary frequency band for detecting a non-welded state in the sub-section;

mapping in the region a combination of calculated subsidiary values of the first and second subsidiary signal power sums;

making a decision for the sub-section of the welding part to have the non-conforming state, as the combination of calculated subsidiary values is mapped in the sub-region; and

concluding a weld quality of the welding part based on the decision for the sub-section.

11. (Original) A laser weld quality monitoring method according to claim 10, wherein the concluding the weld quality depends on a conforming proportion of the sub-section to the welding part.

12. (Original) A laser weld quality monitoring method according to claim 10, wherein one of the first, second, and third subsidiary frequency bands is varied depending on one of a thickness of the work, a welding speed, and an aspect ratio of a keyhole at the sub-section of the welding part.

13. (Currently Amended) A laser weld quality monitoring system comprising:
a welder configured to weld a part of work with a laser beam irradiated thereon from a YAG laser;

a detector configured to detect a varying intensity of light reflected from the welding part to provide a detection signal;

a value determiner configured to determine a value of signal power of a frequency spectrum in a specified frequency band of the detection signal, the specified frequency band having a specific relation with a porous state of the welding part; and

a decision-maker configured to make a decision for [[a]] the porous state of the welding part;

to be significant as the value of signal power exceeds a threshold of weld quality, and

to be insignificant as the value of signal power does not exceed the threshold of weld quality.

14. (Currently Amended) A laser weld quality monitoring system comprising:
welding means for welding a part of work with a laser beam irradiated thereon from a YAG laser;

detecting means for detecting a varying intensity of light reflected from the welding part to provide a detection signal;

value determining means for determining a value of signal power of a frequency spectrum in a specified frequency band of the detection signal, the specified frequency band having a specific relation with a porous state of the welding part; and

decision-making means for making a decision for [[a]] the porous state of the welding part;

to be significant as the value of signal power exceeds a threshold of weld quality, and

to be insignificant as the value of signal power does not exceed the threshold of weld quality.

15. (Currently Amended) A laser weld quality monitoring system comprising:
a laser welder configured to irradiate a laser beam from a YAG laser to a welding part of work;
a detector configured to detect light reflected from the welding part;
a calculator configured to calculate a frequency distribution from a set of data of the detected light within ~~[[a]]~~ an interval of time;
a calculator configured to calculate, from the frequency distribution, a first signal power sum in one of a first frequency band for detecting an under-filled state and a second frequency band for detecting a porous state, and a second signal power sum in a third frequency band for detecting a non-welded state;
an operator configured to map a combination of calculated values of the first and second signal power sums, in a region defined by a combination of a first axis representing the first signal power sum and a second axis representing the second signal power sum, including a sub-region representing a non-conforming state as one of the under-filled state, the porous state, and the non-welded state; and
a decision-maker configured to make a decision for the welding part to have the non-conforming state, as the combination of calculated values is mapped in the sub-region.

16. (Currently Amended) A laser weld quality monitoring system comprising:
laser welding means for irradiating a laser beam from a YAG laser to a welding part of work;
detecting means for detecting light reflected from the welding part;
calculating means for calculating a frequency distribution from a set of data of the detected light within ~~[[a]]~~ an interval of time;
calculating means for calculating, from the frequency distribution, a first signal power sum in one of a first frequency band for detecting an under-filled state and a second frequency band for detecting a porous state, and a second signal power sum in a third frequency band for detecting a non-welded state;
operator means for mapping a combination of calculated values of the first and second signal power sums, in a region defined by a combination of a first axis representing the first

signal power sum and a second axis representing the second signal power sum, including a sub-region representing a non-conforming state as one of the under-filled state, the porous state, and the non-welded state; and

decision-making means for making a decision for the welding part to have the non-conforming state, as the combination of calculated values is mapped in the sub-region.

17. (New) A laser weld quality monitoring method according to claim 1, wherein at least one of a relation between the specified frequency band and the thickness of the work, a relation between the specified frequency band and the welding speed, and a relation between the specified frequency band and the aspect ratio of the keyhole at the welding part, are stored in a memory, and the specified frequency band is determined on the basis of the relation.